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DEREGULATION GONE AWRY: MORAL HAZARD IN THE SAVINGS AND LOAN INDUSTRY

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1 Introduction

The insolvencies of hundreds of thrift institutions (savings and loan associations and savings banks) in the late 1980s traumatized the worlds of both finance and politics. The estimated costs of honoring the federal deposit insurance guarantees on liabilities issued by these insolvent thrifts approach $200 billion on a present-value basis. A financial debacle of such proportions is a testament to the power of moral hazard in a market characterized by high leverage and limited liability.

This paper tests for evidence of moral hazard in the behavior of thrift owners and managers. It differs from previous tests for such behavior, including Benston (1985), Barth, Bartholomew, and Labich (1989), Hanweck and Crockett (1989), Barth, Bartholomew, and Bradley (1990), Cole (1990 and 1993), Demirgüç-Kunt (1990), and Hunter, Verbrugge, and Whidbee (1994), in that it employs a "structure–behavior–outcomes" ap-

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proach that surmounts many of the shortcomings afflicting earlier works.[1] Difficulties that have bedeviled previous efforts include the lack of appreciation of the difficulties of converting reported accounting values into usable economic variables and/or the failure to distinguish between the causes of insolvency and the determinants of the regulators' decisions to close institutions.

The product of this paper is a better understanding of both the causes and costs of thrift insolvencies. Improved understanding should enhance public-policy debates concerning not only the regulation and insurance of banks, thrifts, and credit unions, but also the larger issue of how to minimize the contingent liabilities imposed by federal financial guarantees.

The remainder of this paper is organized as follows: Section 2 presents the basic model and its general application to the thrift debacle of the 1980s. Section 3 discusses the specific application of the model, the econometric tests, and the data used for those tests. Section 4 provides the results of the tests, along with a discussion of the tests themselves. Section 5 provides a brief conclusion.

2 The Model

The potential for moral-hazard behavior by the equity owners vis-à-vis the debt holders of a limited-liability corporation is now a widely understood phenomenon (Williamson, 1963; Jensen and Meckling, 1976; Fama, 1980; Fama and Jensen, 1983). The application of this principle to depository institutions, where federal agencies have been the guarantors to the major creditors (depositors), is now also widely understood (Merton, 1977 and 1978; Sharpe, 1978; Marcus and Shaked, 1984; Ronn and Verma, 1986). This approach to the behavior of the equity holders treats their ownership position as possessing the equivalent of a put option: at any time the equity owners can "put" the company to the creditors and walk away from their investment. The principle of limited liability means that the owners cannot be held responsible for losses to the debt holders beyond their equity investment. Accordingly, in the absence of constraints imposed by the creditors—such as "me-first" bond covenants—the owners prefer to engage in riskier *and* lower expected-value activities than they would

[1] This is similar to the structure–behavior–performance model that frequently is used to test hypotheses in the field of industrial organization. See, for example, Scherer and Ross (1990).

prefer if they had to absorb all losses (e.g., if there were no debt). Gains from positive outcomes accrue to the owners, but losses from negative outcomes are shared with creditors and are limited to the amount of equity investment. Recognizing the incentives inherent in such an arrangement, creditors of commercial firms typically insist upon agreements that restrain the actions of the equity holders and include the equivalent of a call option, so that the creditors at some point may "call" the company from the equity holders.

In the context of federally insured depository institutions, it is the government regulator that, through safety-and-soundness regulation, sets restrictions on the behavior of the depository's owners and sets the terms and the timing for the exercise of the call option (Brumbaugh and Hemel, 1984). This holds true because the uninsured liabilities of most banking firms are small in comparison to their insured liabilities, and because even nominally uninsured liabilities usually have been redeemed at par because of the "too-big-to-fail" policies of the deposit-insurance agencies. The timing of this call option's exercise, however, is influenced by the requirement that the government afford due process to the banking firm's equity holders.

It is well known that the value of the put option for the owners of a depository is a function of the market-value net worth of the depository;[2] the riskiness of the depository's activities as represented by the variance of its expected returns or by assets or activities that generate that variance; the stringency of the regulatory system, including both the formal rules (such as portfolio and activity restrictions, and the vigor of their enforcement); and the fee charged for deposit insurance.[3]

Subject to the constraints imposed by regulatory stringency and the deposit insurance regime, the equity holders will choose the portfolio

[2] This is equivalent to the subsidy element in the deposit insurance arrangement.

[3] This presentation follows the logic of Merton (1977) and Furlong and Keeley (1989). The analysis assumes that owners can easily increase or decrease the net worth of the institution by adding funds (through a capital contribution) or withdrawing funds (through a dividend payment or share repurchase). The net worth of the institution is thus a choice variable for the owners, subject to any regulatory or creditor constraints. In a two-period model, market conditions and the outcomes of other choices concerning risk-taking by owners will determine the second period's income, which owners can then capture through a change in net worth. Since the value of the put option incorporates this second-period outcome, the analysis of owners' choices with respect to the value of the put option is a sensible way to proceed.

configuration and level of net worth expected to maximize their utility, which is a function of the profitability of the depository and the value of the put option. The portfolio selected will have specific risk and return characteristics, and the *ex ante* risk of the portfolio will depend on the level of the depository's net worth and the degree of regulatory stringency. Note that the deposit insurance regime does not enter into the calculus so long as the premiums for deposit insurance are based on a flat-rate structure that is insensitive to the risks undertaken by any individual depository.[4]

From the perspective of the regulator, a depository's net worth is a crucial "outcome" variable. Of special concern are depositories with very low or negative net worth. The net worth of a depository at some future time t is equal to its current net worth plus net income (including both operating income and capital gains or losses), less any dividends paid out (including stock repurchases), plus any equity injections. Net income, dividends, and equity injections are likely to be functions of the interest rates and the regulatory structure during the previous period. Net income also will be a function of the risk level of the inherited portfolio, and (through capital gains or losses) any changes in interest rates or regulatory stringency that occur between times $t-1$ and t.

Based on the foregoing argument, we propose two hypotheses: first, the extent and depth of the thrift insolvencies of the late 1980s were directly caused by thrifts' risk-taking strategies in the early 1980s; and, second, that these strategic behaviors were in turn motivated by the initial structural conditions, such as low net worth and regulatory laxity, facing these thrifts at the beginning of the decade. These hypotheses can be summarized as a structure–behavior–outcomes model: *structure governs behavior, which in turn governs outcomes.*

The next section discusses the specific ways in which these hypotheses are tested.

3 Specific Applications

The structure–behavior–outcomes model provides a framework for testing hypotheses concerning the moral-hazard behavior of thrift operators during the 1980s. This formulation avoids a number of the pitfalls that have

[4] Until the FDIC instituted risk-based deposit insurance premiums in 1992, premiums for banks and thrifts were levied at a fixed rate. Buser, Chen, and Kane (1981), however, argue that differences in regulatory scrutiny create de facto variable premiums.

weakened earlier efforts. In particular, it avoids using portfolio composition close to the date of failure, which reflects asset sales and writedowns, to make inferences about the cause and cost of failure.

In explicating our approach, we proceed "backwards": first outcomes; then behavior; and finally structure. Following this explanation, we describe the specific data and methodology used to test the moral hazard hypotheses.

Outcomes

The potential outcomes for the thrifts analyzed in this study are survival or failure. In the event of failure, the cost of liquidation is also an outcome of interest. Those thrifts that were (a) liquidated or placed with acquirers by the Federal Home Loan Bank Board during the period from 1986 through early 1989, as well as those that were (b) predicted by the Bank Board, as of early 1989, to be extremely likely candidates for liquidation or placement at a cost to the thrift deposit insurance fund, were deemed failures. There are 621 thrifts in this set—266 in group (a) and 355 in group (b).[5] Survival, for a thrift, means that, as of year-end 1989, the institution had tangible net worth equal to at least 3 percent of assets.[6] There are 1,654 thrifts in this category.[7]

This data set has a number of advantages over those used by previous research:

(1) The sample size is large, and the failure group is large relative to the size of the sample.

[5] For thrifts that were placed into the FHLBB's Management Consignment Program (MCP), placement in the program and ultimate resolution are not treated as independent events. This is important because the portfolio composition of a thrift at the time of its placement into the program was fundamentally different from that of the same institution at the time of its ultimate resolution. In a previous study of thrift resolution costs, Barth, Bartholomew, and Bradley (1990) treat the "resolution" of eight MCP thrifts as sixteen independent events, thereby biasing the coefficients of their explanatory variables. See Bisenius, Brumbaugh, and Rogers (1988) for a discussion of the Management Consignment Program.

[6] Tangible net worth is net worth under generally accepted accounting principles less intangible assets, most of which are goodwill with the remainder consisting chiefly of purchased loan servicing.

[7] Those institutions that were solely the acquirer-successors to thrifts that failed during the period 1986–1989 were excluded from the group of "healthy" thrifts, since we are interested in comparing failed thrifts with institutions that did not require disposal during those years.

(2) Virtually all of the failures were caused by asset-quality problems that were likely to be due to moral-hazard behavior rather than to the interest-rate risk problems that caused thrift insolvencies in the early 1980s and were largely beyond the control of the thrifts.

(3) The costs of these failures were estimated by the Federal Savings and Loan Insurance Corporation (FSLIC) using a consistent costing methodology and over a comparatively short time period.

(4) The "surviving" group of thrifts is relatively uncontaminated by likely failures.

In sum, the sample is large and inclusive, with sharply defined outcomes, so that there is a reasonable likelihood of success in determining the role of moral hazard in thrift failures, rather than just explaining the regulators' decisions to close, merge, or liquidate some thrifts among many insolvent or soon-to-be-insolvent candidates.[8]

The sample may contain some classification errors. The Bank Board's 1989 list of seriously troubled thrifts failed to identify a number of thrifts subsequently closed by regulators. Thus, the group of failures is underrepresented. Moreover, some of the "surviving" thrifts were closed after 1989, while a few of the "failing" thrifts have survived. In order to delineate the sample sharply, thrifts that are neither in the "failing" group nor in the well capitalized "surviving" group are excluded from the analysis.[9] On balance, however, the strengths of this sample far outweigh its drawbacks, so that it is most suitable for the purposes of the present study.

The outcomes consist of a binary representation for each thrift—survival or failure—along with the estimated liquidation costs to the deposit insurance fund for each of the failing thrifts, where the cost is expressed as a proportion of total liabilities.[10] Where placement with acquirers rather than liquidation occurred, estimated liquidation costs are used rather than the estimated costs of placements with acquirers so as to provide greater

[8] Cole (1993) analyzes and finds significant differences in the determinants of book-value insolvency and the determinants of regulatory closure.

[9] Excluded from the group of "healthy" thrifts are those institutions that were solely the acquirer-successors to thrifts that failed during the period 1986–1989, since the focus is on a comparison between the failed thrifts and thrifts that did not require disposal during those years.

[10] Total liabilities is superior to total assets as a deflator for this purpose because total assets reflect writedowns. In the extreme case, a total writedown of a single asset would result in an infinite ratio of liquidation cost to assets.

standardization for the cost variable and to avoid the necessity of including variables to explain the determinants of the cost reduction achieved through placements.[11]

A limitation of the cost data should be acknowledged. The actual disposal cost for an insolvent thrift is known only when its last asset is sold; for some thrifts, this last sale may not occur for as long as a decade after closure. These cost estimates, then, are forecasts based on a costing methodology developed by the FSLIC in the mid-1980s, incorporating its prior experiences with the disposal of insolvent thrifts. To the extent that actual market conditions changed after the FSLIC's methodology was developed (or that the methodology mischaracterized the FSLIC's experiences), actual costs will differ from estimated (forecasted) costs. In an important sense, then, the results reported in this chapter more directly concern the determinants of the FSLIC's cost estimates, rather than the determinants of the actual costs—because the latter were still unknown at the time of this study. To the extent that FSLIC's costing methodology was an accurate representation of its experiences and a reasonable forecast of its future costs, however, the results provide worthwhile evidence on the determinants of thrift failure costs.[12]

Behavior

The behavior of each thrift between year-end 1982 and year-end 1985 is represented by the compound annual growth rate of liabilities over these three years, by its portfolio allocation to major categories of its year-end 1985 balance sheet, and by some components of its expenses for the calendar year of 1985.

This choice of these dates is appropriate for the following reasons. During 1982, the second of the two major federal deregulation acts, the Garn–St Germain Depository Institutions Act, was passed.[13] Around this

[11] One such factor is the value of tax benefits granted to acquirers. See Kormendi *et al.* (1989). Other factors include potential economies of scale or scope that may arise as a result of a placement, and the value of the firm as a going concern due to expertise and preexisting customer relationships.

[12] Virtually all studies analyzing the costs of thrift and bank failures have been forced to use data derived from estimated rather than actual costs simply because actual cost data have not been available.

[13] The first act, the Depository Institutions Deregulation and Monetary Control Act, was passed in early 1980. For discussion of these acts and their provisions, see Garcia and Cargill (1985), White (1986), and White (1991, ch. 5).

time, a number of states enacted substantial deregulation measures for their state-chartered thrifts.[14] Year-end 1985 marks the end of a period of rapid growth for most thrifts and the last year of the FSLIC's "official" solvency.[15] Also, around this time a greatly expanded field staff of regulatory personnel was starting to scrutinize thrift portfolios more closely, and more stringent regulations began to restrict thrifts' behavior.[16] More importantly, this is a time *before* thrifts began to take substantial write-downs of bad assets.

This last point is crucial. Virtually all of the studies that have tried to relate thrift failures and/or failure costs to thrifts' portfolio choices have measured their asset compositions by their balance-sheet values either just prior to insolvency or just prior to closure. This is *after* substantial write-downs and asset sales have occurred. Data chosen in this manner are likely to yield biased and misleading results.

An example will illustrate this point: Suppose that, at time t, a thrift with net worth equal to 5 percent of assets invests 90 percent of its asset portfolio in asset A (e.g., conventional home mortgage loans) and 10 percent in asset B (e.g., commercial real estate). At time $t+1$, examiners classify asset B as a total loss, forcing the thrift to write down its value to zero so that it disappears from the thrift's balance sheet; the thrift is now seriously insolvent, with net worth of -5.6 percent of assets. At time $t+2$, regulators liquidate the thrift.

Any statistical efforts to relate the failures (or the costs of failures) of thrifts like this to balance-sheet compositions at either time $t+2$ or time $t+1$ will completely miss the asset that was the cause of the failure.[17] Only a "snapshot" of balance sheets at time t provides the proper basis for attributing the causes of the failures. Accordingly, this study focuses on three categories of behavioral indicators measured as of 1985.

The first category of behavioral variables is represented by the asset and liability portfolio allocations that thrifts reported on their year-end 1985 balance sheets. By this time, thrifts had ample opportunity to invest in

[14] In general, state-chartered thrifts have investment powers at least as liberal as those enjoyed by their federal-charter counterparts.

[15] Over the years 1982–88, the annual percentage growth rates for industry assets were as follows: 1982, 6.23; 1983, 17.10; 1984, 19.32; 1985, 9.47; 1986, 8.77; 1987, 7.48; and 1988, 7.97. Growth rates for thrifts in the state of Texas were considerably higher than for those located in the rest of the nation.

[16] For more detail on this period, see White (1991, ch. 6).

[17] Partial write-downs, of course, will mean under-representation of the assets that cause failure, which will bias parameter estimates.

previously prohibited asset classes so as to diversify their portfolios and achieve the superior risk-return mix that can come with diversification.[18] Alternatively, thrifts could use the new opportunity set for undertaking higher risk, moral-hazard-laden investments.

Most previous studies of thrift performance identify "nontraditional" thrift assets—land loans, nonresidential mortgages, commercial loans, direct real estate equity investments, other direct equity investments, and service corporation investments—as possible or likely sources of losses for thrifts (Benston, 1985; Benston and Koehn, 1988; Benston and Brumbaugh, 1988; McKenzie, Cole, and Brown, 1992; Cole, 1990 and 1993; Cole and McKenzie, 1994). Here, these same asset categories are used to test for moral-hazard behavior, but they are included in a superior form: They pre-date the reporting periods in which substantial write-downs were likely to occur.[19]

The specific portfolio vector includes all financial asset classes, expressed as proportions of total assets, except one- to four-family mortgages, mortgage-backed securities, and liquid assets. These latter asset classes are excluded because of their minimal credit risk. The included variables are:

(1) multifamily mortgage loans that are secured by residential properties with five or more units;
(2) nonresidential mortgage loans that are secured by commercial structures;
(3) land loans, including loans for the acquisition and development of land and also for raw land;
(4) unsecured commercial loans;
(5) consumer loans, such as automobile loans and credit card receivables;
(6) real estate held for investment or development purposes (this represents equity interests in real estate projects, and does not include the institution's offices);

[18] Cole and McKenzie (1994) explore the potential for asset diversification by thrifts during the 1980s.

[19] To test whether thrifts used these nontraditional assets for diversification as well as for moral-hazard risk-taking, the balance sheet variables were interacted with a dummy variable that took the value one if the thrift's year-end 1985 tangible net worth was greater than three percent and zero if otherwise. These interaction variables generally are not statistically significant, so they are not reported here.

(7) service corporation investment (service corporations are separately capitalized subsidiaries most often engaged in real estate development); and

(8) equity securities, excluding the thrift's stock in its regional Federal Home Loan Bank.

A second behavioral category is the expenses incurred during calendar year 1985. Specifically included in the model is the sum of directors', officers', and employees' expenses; furniture, fixtures, equipment, and automobile expenses; legal expenses; compensation expenses; and occupancy expenses (collectively referred to as expense-preference items). All are managerial choice variables that serve as potential indicators of expense-preference behavior. High levels of these expenses may indicate the presence of moral-hazard behavior benefiting owners and managers at the expense of creditors, including the deposit insurer (Jensen and Meckling, 1976; Verbrugge and Jahera, 1981; Fama and Jensen, 1982; Akella and Greenbaum, 1988; Blair and Placone, 1988; Kane, 1989; Cole, 1990 and 1993).

The third behavioral category is the extent of growth during the 1982–1985 period. Rapid growth is a likely indicator of moral-hazard behavior, since rapid growth provided thrift operators with the best avenue for taking advantage of the new opportunities that deregulation presented to them. Even under the best of circumstances, rapid growth places strains on an organization and increases the likelihood of costly errors. For thrifts facing expanded opportunities for investing in previously prohibited asset classes, the likelihood that rapid growth would lead to losses was exacerbated.[20]

Three measures of growth are analyzed. The first and primary measure is the percentage growth in total liabilities from year-end 1982 to year-end 1985. Two supplementary indicators of rapid growth are the proportions of a thrift's liabilities accounted for by deposits obtained through brokers, and by "jumbo" deposits of sizes greater than $100,000. Brokered deposits and reliance on wholesale funds do not by themselves cause failure, but they do enable a thrift to circumvent the constraints imposed by local retail deposit markets in implementing a rapid-growth, high-risk investment strategy.

Because the accumulation of goodwill might have been part of a rapid growth-by-merger strategy, goodwill also is included as an explanatory

[20] Growth through merger as well as through internal expansion is included because mergers can lead to the same type of strain on organizations.

variable. This permits a test to see if the "intangible" assets represented by goodwill had an effect on the likelihood of a thrift's failure. (Since the cost variable is the estimated cost of liquidation, goodwill assets should have imposed a dollar-for-dollar loss in the cost estimates.)

Structure

The structural characteristics chosen for analysis are represented by a set of variables focused primarily on year-end 1982. According to the model discussed in section 2, a thrift's net worth and regulatory environment should be major determinants of its risk-taking. Though the model is presented in terms of simultaneous risk-taking in response to the structural variables, actual behavior is unlikely to occur instantaneously. Consequently, choosing structural variables for year-end 1982 to explain subsequent behavior, measured as of 1985, and subsequent outcomes, measured as of 1986 through 1989, seems reasonable.

Further, measurement of a thrift's net worth at a point in time substantially earlier than its failure is more likely to capture a structural characteristic that could lead to moral-hazard behavior than is measurement at a point closer to the time of failure.[21] The latter measurement would more likely be an imperfect reflection of the insolvent thrift's eventual disposal cost rather than a predictor of likely moral-hazard behavior, especially since the regulatory regime (at least since 1986) considerably tightened its scrutiny and control over undercapitalized or insolvent thrifts.

Three variables are used to measure the effects of a thrift's market-value net worth. The first is its tangible net worth reported as of year-end 1982. The drawback to this measure is that it is based on historical cost accounting and does not include the decrease in market value of a thrift's portfolio of low-coupon mortgages due to the relatively high interest rates prevailing during 1982. To capture this element of market value, the thrift's net interest margin for the second half of 1982,—the difference between the interest it earned on its assets and the interest it paid on its liabilities—expressed as a ratio to assets, is also included in the model. This variable should indicate the severity of a thrift's interest-rate mismatch and thus provide an additional measure of its market-value net

[21] Most previous studies, including Benston (1985) and Barth, Bartholomew, and Bradley (1990), have taken data immediately prior to, or one or at most two years prior to, actual failure. Cole (1990, 1993) takes data from the last accounting period in which an institution reported positive GAAP net worth.

worth. A third variable included as a measure of market value is the thrift's size, expressed as the logarithm of year-end 1982 assets. This variable is included to proxy for the "franchise value" of a failed thrift, which is likely to be positively related to its asset size.

The risk profile of a thrift's chosen portfolio depends in part on the risk profile of its inherited portfolio. Moral-hazard-laden behavior is more evident in the *changes* in the riskiness of the portfolio than in degree of portfolio risk. One way to measure the initial portfolio risk is to calculate a summary measure of portfolio risk similar to the denominator of the ratio of capital to risk weighted assets adopted in 1990 by bank and thrift regulators in response to Section 301 of the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA). This measure, the ratio of risk-weighted assets to total assets, is calculated using 1982 balance sheet data and the following set of risk weights: 0.00 for eligible liquid assets, 0.20 for other liquid assets (including mortgage-backed securities), 0.50 for one- to four-family mortgages, and 1.00 for other assets. These weights replicate those in the Basel Accords, which were developed much later than 1982 and may have been influenced by events in the 1980s. This variable, however, is a summary measure, albeit imperfect, of the riskiness of the portfolio before the period of asset deregulation and rapid growth.

Moral-hazard incentives also would be affected by the organizational form of the thrift. As late as 1980, 80 percent of all thrifts (accounting for 73 percent of all thrift assets) were mutual in organization, rather than stockholder-owned. In a mutual thrift, the managers are more concerned with protecting their jobs than maximizing the value of the firm because they cannot capture the full benefits from the favorable outcomes from risk-taking. Thus, the moral-hazard problem should be less severe for mutual thrifts than for stock thrifts. Publicly traded stock thrifts with professional managers who only share to a limited extent in the favorable outcomes, however, should behave more like mutuals than should closely held stock thrifts, where owners also serve as managers and can capture the full benefits of favorable outcomes. Further, the different (and, some have charged, appreciably more lax) regulatory regimes that applied to state-chartered thrifts could affect the moral-hazard incentives of both stock and mutual thrifts.

To model these differential effects, dummy variables are constructed to indicate state-chartered stock thrifts, state-chartered mutual thrifts, and federally chartered stock thrifts; the federally chartered mutual thrift

category serves as the reference group. Also included in the model is a dummy variable indicating a publicly traded stock thrift.[22] These variables reflect organizational structure as of year-end 1982.

Another set of dummy variables is constructed to indicate thrifts located in Texas, California, and Florida. Thrifts chartered in theseS&Ls,in Texas, California and Florida states faced more liberal asset restrictions and experienced above-average failure rates. Also included in the model are dummy variables indicating state-chartered thrifts located in the three states. These six variables should provide evidence for assessing the competing hypotheses (a) that regional economic conditions contributed most to differential failure rates, and (b) that lax state regulation played the major role.

A final dummy variable is included in the model to indicate thrifts that were located in the Ninth Federal Home Loan Bank District, which includes the states of Arkansas, Louisiana, Mississippi, New Mexico, and Texas. This variable is included to test for any adverse consequences from that District Bank's move of its headquarters from Little Rock to Dallas in 1983, at which time almost all of the supervisory staff resigned so as to avoid moving from Little Rock. This move left the Ninth District with a very small and inexperienced supervisory staff during the period just after deregulation, when thrifts in that District embarked on strategies of rapid growth into newly permitted asset classes.

The data and the specific variables

The primary source of data is the semiannual (through 1983) and quarterly (since March 1984) thrift financial reports compiled by the Bank Board until its 1989 demise and since then by the Office of Thrift Supervision. This database provided all of the behavioral variables and most of the structural variables. The outcome variables were compiled by the staff of the FSLIC. The data on publicly traded thrifts were compiled by the Bank Board staff.

[22] Ideally, a variable to indicate whether a change of control of the thrift occurred in 1982 (e.g., bringing in a more aggressive entrepreneur) should be included; unfortunately, the relevant data were not available.

Specific tests

The structure–behavior–outcomes model provides a rich array of tests of the underlying hypotheses. The first test is for the relationship between outcomes and behavior:

$$Probability\ of\ Failure_i = f(X_i) \quad (1)$$

$$Liquidation\ Cost_i = g(X_i, Fail86_i, Fail87_i, Fail88_i) \quad (2)$$

where *Probability of Failure*$_i$ and *Liquidation Cost*$_i$ represent the outcomes failure and expected liquidation cost, respectively; X_i is the vector of behavioral variables from Table 1;[23] and *Fail86*$_i$, *Fail87*$_i$ and *Fail88*$_i$ are dummy variables indicating whether the liquidation cost for the failed thrift was estimated during 1986, 1987, or 1988, respectively. These dummy variables are included to control for any differences in costing methodologies or discount-rate assumptions that the FSLIC might have used in these years, as compared with the omitted category (1989 cost estimates). These variables also could be measuring cost differences among thrifts that are not captured by the other variables.

Since *Probability of Failure*$_i$ is a binary dependent variable, the assumptions of ordinary least squares (OLS) regression analysis are not satisfied. In this situation, application of OLS results in biased and inconsistent parameter estimates. Unbiased and consistent parameter estimates of *Probability of Failure*$_i$ are obtained using a probit maximum-likelihood procedure.

OLS regression also may be inappropriate for estimation of *Liquidation Cost*$_i$. Unless the thrift institutions for which costs are available constitute a random sample of all thrifts, use of OLS (or some variant thereof) may result in biased coefficients. Clearly, a sample of thrift institutions that have failed or are expected to fail may not be representative of the universe of thrift institutions. If one can control for the non-random nature of the failed sample by a complete specification of all variables that determine the cost of liquidation, OLS still will produce unbiased and consistent parameter estimates. If there are unobserved variables that affect both the likelihood of closure and the cost of liquidation, however, the error terms in equations (1) and (2) will be correlated due to an overlap in omitted variables. Estimation procedures that ignore this correlation will produce biased coefficients for equation (2). Heckman (1979) proposes a two-step

[23] All of the tables for this chapter are displayed consecutively, starting after page 57.

procedure to compensate for this correlation in error terms. His procedure produces unbiased and consistent, but not fully efficient, parameter estimates. The joint estimation of equations (1) and (2) by the method of full-information maximum likelihood (FIML) suggested by Amemiya (1973), however, can be used to produce unbiased and asymptotically efficient parameter estimates.[24]

As a second test, one can "look through" behavior and test for the relationship between outcomes and structure:

$$Probability\ of\ Failure_i = h(Z_i) \quad (3)$$

$$Liquidation\ Cost_i = j(Z_i, Fail86_i, Fail87_i, Fail88_i) \quad (4)$$

where Z_i is the vector of structural variables from Table 1. Again, the same methodological considerations apply to the estimation of equations (3) and (4).

Third, because neither the behavioral variables alone nor the structure variables alone may be capturing the full explanatory power of the data set, one can combine them:

$$Probability\ of\ Failure_i = k(X_i, Z_i) \quad (5)$$

$$Liquidation\ Cost_i = l(X_i, Z_i, Fail86_i, Fail87_i, Fail86_i) \quad (6)$$

Fourth, one can test for the intervening relationships between behavior and structure. This can be done through individual OLS regressions where the individual behavioral variables are estimated as a function of the vector of structural variables:

$$x_i = m(Z_i), \quad (7)$$

[24] Heckman (1979) provides the original derivation of the selection model, while Maddala (1986) discusses many econometric issues related to the resolution cost estimation problem. Actual estimation was carried out using the LIMDEP statistical package developed by Greene (1989). The particular methodology used here is similar to that proposed by Amemiya (1973): consistent maximum-likelihood probit probability-of-failure estimates and least-square cost-of-liquidation estimates are used as starting values for the estimation of final parameter coefficients using a modification of the Davidon, Fletcher, and Powell algorithm. As Greene (1989) points out, obtaining convergence with this procedure often is problematic, especially with as many parameters as are estimated in this particular application. To facilitate convergence by reducing the number of parameters to be estimated, variables with p-values greater than 0.20 in the single-equation probit and OLS results are deleted from subsequent estimation of the simultaneous-equation FIML model.

where x_i is an individual behavioral variable. Discussion of the results from each of these four sets of tests appears in Section 4.

4 Results

Simple statistics

Table 1 provides the mean values of the model's outcome, behavioral, and structural variables for the entire sample of thrifts and, separately, for the "failing" and "surviving" groups of thrifts. Also presented are *t*-tests for significant differences in the mean values of the failing and surviving groups. Included for completeness in these comparisons of means are a number of asset and liability categories that are not included in the subsequent regression results. For each thrift, all of the continuous variables (except for *Size*, the log of total assets) have been scaled either by total liabilities or, more commonly, total assets. Overall, 27.3 percent of the sample thrifts (621 of 2,275) are classified as failures, and their mean estimated liquidation cost is 34.5 percent of year-end 1985 total liabilities.

Structural characteristics measured as of year-end 1982 show sharp contrasts in the failing and surviving groups. Failing thrifts reported significantly lower tangible net worth ratios and net interest margins, but significantly higher ratios of risk-weighted-asset ratios and levels of assets. State-charter and, to a lesser extent, federal-charter stock thrifts are significantly over-represented in the group of failing thrifts, which is supportive of the hypothesis that moral hazard incentives were affected by organizational form. Also significantly over-represented in the failing group are thrifts located in the Ninth FHLB District (41 percent of failing thrifts but only 16 percent of the entire sample) and thrifts located in Texas (30 percent of failing thrifts but only 10 percent of the entire sample). These results support the notion that the combination of a regional economic shock (the collapse in oil prices during 1982 and 1986) and a shortage of supervisory resources in the Ninth District FHLB greatly increased the incentives for moral hazard at thrifts located in the Southwest.

Differences in year-end 1985 asset portfolio allocations of the failing and surviving groups also are sharp. Failing institutions held higher proportions of all asset categories except one- to four-family mortgages and mortgage-backed securities. As compared with the surviving institutions, failing thrifts held twice the proportion of nonresidential mortgage loans, *nine* times the proportion of land loans, *eleven* times the proportion of equity real estate investment, *five* times the proportion of equity service corporation investment, and *eight* times the proportion of goodwill. The differences in means of the surviving and failing groups are significant at least at the 0.1 percent level for all asset categories except equity securities and junk bonds.[25] Thus, it is clear that failing thrifts invested earlier and more heavily in nontraditional assets, whereas surviving thrifts stuck to their core business of funding residential mortgages.

Differences in year-end 1985 liability portfolio allocations are similar. Relative to surviving thrifts, failing thrifts held almost twice the proportion of wholesale deposits, *six* times the proportion of brokered deposits, and twice the proportion of repurchase agreements. In addition, failing thrifts' liability growth during the 1983–1985 period was almost three times that of surviving institutions.

From year-end 1982 to year-end 1985, the average tangible net worth ratio of the failing institutions declined from 2.4 percent to negative 2.4 percent, a 480 basis point decline, whereas the surviving institutions lost only 30 basis points, from 5.5 percent to 5.2 percent.

Estimates of the probability of failure

Table 2 presents three sets of parameter estimates for the effects of the structural and behavioral variables on the probability of failure. In the second through fourth columns are single-equation OLS estimates of the failure model, which are presented for their intuitive clarity; in the fifth through seventh columns are single-equation probit estimates of the failure model; and in the last three columns are FIML estimates of the failure model, which is jointly estimated with the cost of liquidation model. Each set of estimates includes a specification including only structural variables, a specification including only behavioral variables, and a combined structure–behavior specification.

In each of the nine specifications, most of the explanatory variables have the hypothesized signs and are highly significant. In the structure-only specifications, the 1982 tangible net worth ratio is the most significant

[25] The junk bond variable presents a problem. The thrift industry's largest holder of junk bonds, by far, was Columbia Savings of Beverly Hills, and it was not included as a likely failure in the Bank Board's 1989 listing. Of course, Columbia Savings ultimately failed. The junk bond variable comes close to serving as a dummy variable for Columbia Savings, whose outcome was misclassified.

determinant of failure. Thrifts with lower net worth in 1982 were significantly more likely to fail during 1986–89, consistent with the hypothesis that moral hazard led the owners and managers of these undercapitalized thrifts to take more risks than did their better capitalized counterparts. Other variables significant in both the structure-only and the combined specifications include dummies indicating state-stock and federal-stock charters, Texas thrifts, and thrifts located in the Ninth FHLB District. The positive coefficients and high statistical significance of the two dummies indicating stock charter provide strong evidence that moral hazard was a greater problem at stock than at mutual thrifts. Thrifts located in Texas and in the Ninth FHLB District were significantly more likely to fail, consistent with the hypothesis that the supervision problems in that district significantly contributed to the disproportionate number of failures in the Southwest. None of the three dummy variables indicating state-chartered thrifts located in Texas, California, and Florida is consistently significant. These results indicate that, after controlling for the effects of other structural and behavioral characteristics (including stock organization), the effects of state chartering were not important in determining the likelihood of failure.[26]

The ratio of risk-weighted assets to total assets is positive and highly significant in the structure-only specifications, but is not significant in the combined specifications. This suggests that variation in the asset-portfolio variables better accounts for the effect of asset risk on the probability of failure than does the summary risk-weighted assets measure. Net interest margin is negatively related to failure and highly significant in the combined specification, but is only marginally significant in the structure-only specification.

In the behavior-only and the combined specifications, the asset-portfolio variables with the greatest influence on the probability of failure are the proportions of land loans, nonresidential mortgages, and goodwill: all are

[26] State regulatory regimes have been quite varied. Some (e.g., in the Northeast and Midwest) were generally considered more conservative than others (e.g., the Southwest and West). State-chartered thrifts in the Northeast were more likely to be mutuals; state-chartered thrifts in the Southwest and West were more likely to be stocks. Thus, the state-stock and state-mutual variables may be correlated with lax and stringent regulatory regimes, respectively; without an independent identification of the lax or the conservative nature of each state regime, however, it is difficult to be more definitive. These results do make clear, however, that one cannot condemn state regulation uniformly as adding to the thrift debacle.

positive and statistically significant at the 0.1 percent level. The proportions of commercial loans and equity real estate investments are also positive and are significant at the 1 percent level in both the behavior-only and the combined specifications.[27] These results provide additional evidence that moral hazard manifested itself in the form of excessively large portfolio portions allocated to non-traditional assets.

On the liability side, the proportion of brokered deposits is positive and significant in both specifications, and the liability growth rate over 1983–85 is positive and significant in the combined specification. These results, coupled with the strong positive and significant relationship between goodwill and failure, indicate that a strategy of rapid growth funded with volatile liabilities increased the probability of failure even after controlling for other structural and behavioral variables.

Finally, the ratio of expense-preference items to assets is positive and significant in the combined specification, providing evidence that excessive perquisite consumption by the owners and manager of failing thrifts significantly increased the likelihood of failure.

Specifications that include both the behavioral and the structural variables provide results that generally are consistent with the separate behavior-only and structure-only specifications. The overall explanatory power of the model rises when the full specification is employed, however, as evidenced by the increases in the log-likelihood, adjusted R^2, and pseudo R^2 statistics. The pseudo R^2 statistics indicate that the structure-only and behavior-only specifications explain about a third of the variation in the failure variable, whereas the combined specification explains almost half of this variation. All of these results provide strong support for the moral-hazard-behavior hypotheses.

The estimated costs of failure

Table 3 presents parameter estimates for the effects of the structural and behavioral variables on the expected cost of liquidation expressed as a proportion of year-end 1985 liabilities. Again, three sets of parameter estimates are presented. In the second through fourth columns are single-equation OLS estimates; in the last three columns are the FIML estimates;

[27] With the exception of Cole (1990, 1993), previous researchers have lumped real estate investment together with service corporation investment, confounding the effects of these asset classes. Benston (1985) and Barth, Bartholomew, and Bradley (1990), for example, report that direct investment was not a significant determinant of failure.

and in the fifth through seventh columns are OLS results corresponding to the pared-down FIML specifications. As with the failure results, each set of cost estimates includes a structure-only, a behavior-only, and a combined structure-behavior specification.

In general, all three sets of estimates are similar. Because of their theoretical superiority, the FIML results are the focus of discussion. Further, because the results of the combined specifications are generally quite consistent with the separate structure-only and behavior-only specifications, only the combined results are discussed in detail.

Only two of the structure variables—dummies indicating Texas state-chartered thrifts and thrifts located in the Ninth FHLB District—are significant in both the structure-only and the combined FIML specifications. Both are positive, indicating that, after controlling for other structural and behavioral variables, Ninth District thrifts were more costly to liquidate than thrifts located elsewhere, and that Texas state-chartered thrifts were even more costly to liquidate than other Ninth District thrifts. These results provide additional evidence strongly supportive of the hypothesized deleterious effects associated with the Ninth District FHLB's move from Little Rock to Dallas, and also suggest a breakdown in the supervision of state-chartered thrifts by the Texas S&L Commission.

Four additional structural variables are highly significant in the structure-only specification—*Risk-Weighted Assets*, *Tangible Net Worth*, and *State-Stock Charter* and *Federal-Stock Charter*. All but tangible net worth are positive, indicating positive associations with liquidation costs. The negative coefficient of tangible net worth provides additional support for the hypothesis that moral hazard was a more serious problem for undercapitalized thrifts, which subsequently took on more risk than their better capitalized counterparts and consequently were more costly to liquidate when they failed. The positive coefficients on the two stock-charter variables bolster the hypothesis that the moral-hazard problem was more severe at stock than at mutual thrifts and, in conjunction with the insignificance of the state mutual variable, tend to refute charges that state thrift regulators (other than in Texas) were unduly lax.

Two of the behavioral variables—*Land Loans* and *Service Corporation Investments*—are significant at the 0.01 percent level in both the behavior-only and combined FIML specifications. *Expense Preference Items* is significant in both specifications at the 5 percent level. All three of these behavioral variables have the expected positive sign, indicating that higher

values are associated with higher expected liquidation costs. Three additional behavioral variables—*Nonresidential Mortgages*, *Commercial Loans*, and *Goodwill*—are statistically significant in the combined specification but not the behavior-only specification. All three are positive in the combined specification.

The magnitudes of the coefficients associated with the variables in Table 3 indicate the expected cost burden (i.e., the additional liquidation cost or, equivalently, the decrease in asset value) per dollar of liability incurred by these failing thrifts as of year-end 1985, after controlling for all other structural and behavioral variables. For example, in the combined FIML specification, the 0.139 coefficient on *FHLB District Nine Membership* indicates that failing Ninth District thrifts imposed an additional liquidation cost of 14 cents per dollar of liability, after controlling for other factors. The 0.153 coefficient on *Texas State Charter* indicates that Texas state-chartered thrifts imposed an additional liquidation cost of 15 cents per dollar of liability. The 1.018 coefficient on goodwill is not significantly different from one, consistent with the hypothesis that the goodwill of failing thrifts has no value in liquidations. None of the liability variables are significant in either of the specifications. Interestingly, this indicates that, after controlling for other structural and behavioral factors, rapid growth by other than a merger strategy did not significantly increase the cost of failure. Of the three dummy variables identifying the year in which the liquidation cost was estimated, only the 1988 dummy, which is positive, is statistically significant. This result implies that institutions whose liquidation costs were estimated during 1988 were expected to be more costly to liquidate than the structural and behavioral variables relevant to these thrifts would otherwise indicate.[28]

Comparison of the failure and cost models

Only one of the structure variables—*FHLB District Nine Membership*—is statistically significant in the combined specification of both the FIML failure and cost models. Four additional variables—*Risk-Weighted Assets*, *Tangible Net Worth*, *State-Stock Charter*, and *Federal-Stock Charter*—are

[28] It could be that the estimation methodology used in 1988 differed somehow from that of the years before or after, but since the same models and procedures were used, and the same staff did the analysis, this is unlikely.

significant in the structure-only specifications of both models. All of these variables except tangible net worth are positive.[29]

Five of the behavioral variables—*Nonresidential Mortgages*, *Land Loans*, *Commercial Loans*, *Goodwill*, and *Expense Preference Items*—have significant and positive signs in the combined specifications of both the FIML failure and cost models. In addition, the *Service Corporation Investments* variable is positive and significant in the behavior-only specification of both FIML models.

Was the thrift crisis a Southwestern regional phenomenon?

Because of the concentration of thrift failures and failure costs in the Southwest, some observers have dismissed the thrift crisis as a regional phenomenon. To see if the general findings of this study are driven by Southwestern institutions, the FIML model is reestimated using a sample that excludes thrifts located in the Ninth FHLB District. This reduces the sample size to 1,904 thrifts, of which 364 are classified as failures. The last four columns of Table 1 provide the mean values for this restricted sample and, separately, for the failing and surviving thrifts in the restricted sample, as well as *t*-tests for differences in the mean values of the failing and surviving groups. Comparisons of these statistics with the corresponding statistics for the unrestricted sample, which also appear in Table 1, reveal that the restricted sample is not qualitatively different from the unrestricted sample; i.e., the results hold for thrifts outside of the Southwest as well as for Southwestern thrifts.

Using this restricted sample, the FIML combined specification (including both structural and behavioral variables) is reestimated, and those results appear in columns 2 and 3 of Table 4. To facilitate comparisons, results for the FIML combined specification from Tables 2 and 3 are reproduced in columns 4 and 5 of Table 4. As with the descriptive statistics, a comparison of these results demonstrates that the estimates for the non-Southwestern sample are not qualitatively different than those for the full sample, although coefficients are somewhat different and *t*-statistics are somewhat lower. With the exception of the *Texas* and *Ninth FHLB District Membership* variables (which must, of course, be deleted from the non-Southwestern specification) and the *Commercial Loans* and *Brokered Deposits* variables, each remaining variable that is statistically significant for the full sample also is significant in the restricted sample, and has the same sign. This holds for both the failure equation and the cost of liquidation equation. These results strongly refute arguments that the thrift crisis was strictly a Southwestern, regional phenomenon, and demonstrate that the fundamental findings of this study apply to the entire thrift population.

[29] Further research is needed to determine whether or not the insignificance of the risk-weighted asset variable in 1982 is collinear with 1985 asset allocation. Table 5 indicates that this variable is a significant determinant of a number of 1985 behavioral measures.

Behavior and structure

One basic hypothesis still to be tested is that a set of structural characteristics gave rise to certain behaviors. Table 5 provides evidence on these relationships, reporting regression results where the dependent variables are the individual portfolio characteristics as of 1985 and the independent variables are the structural characteristics as of 1982. For expositional simplicity, only coefficients significant at least at the 5 percent level are reported, but all relationships are estimated with the full vector of structural characteristics. The small mean values of the dependent variables (presented in Table 1) must be considered in interpreting these results, in that some of the reported coefficients on the regional and structural dummy variables are a multiple of this mean.

There are several general conclusions. First, institutions with higher levels of capital and lower levels of risk-weighted assets in 1982 invested proportionately much less in nontraditional assets. Tangible net worth is negative and significant in explaining five of ten asset categories and insignificant in the remaining five, whereas the risk-weighted assets variable is positive and significant in explaining seven of ten asset categories and insignificant in the remaining three. Well capitalized institutions also relied much less heavily on volatile deposits liabilities (i.e., wholesale deposits, brokered deposits, and repurchase agreements) in funding their operations. Second, stock-charter institutions invested greater proportions of their assets in these nontraditional asset categories and used wholesale funds to a greater extent than did mutual institutions. The state-stock variable is positive and significant in explaining eight of ten asset categories and all three volatile liability categories, while the federal stock variable is positive and significant in explaining six asset categories as well as wholesale deposits.

Third, institutions located in the Ninth FHLB District invested more heavily in most nontraditional assets and depended more heavily on bro-

kered and jumbo deposits than did institutions in the other eleven FHLB Districts. The Ninth FHLB District variable is positive and significant in explaining nonresidential mortgages, land loans, unsecured commercial loans, and consumer loans, as well as wholesale and brokered deposits.

Fourth, larger institutions invested more heavily in nontraditional assets. Asset size is significant in explaining eight of the ten asset categories, and seven are positive relationships.

Overall, these results are generally consistent with the earlier behavior-outcomes and structure-outcomes results.

5 Conclusions

This article uses a structure–behavior–outcomes paradigm to model the experience of the thrift industry during the 1980s, and then tests this model using data and methodology that avoid many of the problems that have weakened the findings of earlier studies. The results provide strong support for the hypothesis that moral-hazard-laden behavior was a critical factor explaining the failures and liquidation costs of more than 600 thrifts during the late 1980s. The results also provide a clearer picture of the ways in which this behavior manifested itself.

In general, the results indicate that the net worth and organizational structures of thrifts as measured in 1982 were important determinants of the subsequent behaviors of these institutions in the period until 1985, and of outcomes in the period 1986–1989. Further, it appears that the proximate causes of the failures and liquidation costs of the hundreds of thrifts closed during this latter period were (with some exceptions) their investments in nontraditional assets that, for the most part, had been proscribed prior to deregulation in the period 1980–82. It does appear that there was a regional aspect to the thrift crisis; failures and failure costs were especially severe among the thrifts in the Southwest. Further analysis, however, reveals that the model and results apply almost as strongly to thrifts outside of the Southwest.

These results lend force to the policies mandated by FIRREA and FDICIA, requiring depository institutions to maintain higher levels of capital and tying both capital levels and deposit insurance premiums to the riskiness of a depository's asset portfolio. They also support efforts to ensure that such institutions are adequately examined, and promptly closed when determined to be critically undercapitalized.

Further research should be able to refine the hypotheses and methods presented here. The approach of specifying structure, behavior, and outcomes separately, and of collecting the data and testing the hypotheses in ways consistent with this specification, offers a useful means of understanding the experience of the thrift industry during the 1980s.

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TABLE 1

UNIVARIATE STATISTICS FOR VARIABLES USED TO EXPLAIN THE PROBABILITY OF FAILURE AND THE COST OF LIQUIDATION FOR THRIFTS

	All FHLB Districts				All FHLB Districts Except District Nine			
Variable	All Thrifts	Failing Thrifts	Surviving Thrifts	*t*-stat[a]	All Thrifts	Failing Thrifts	Surviving Thrifts	*t*-stat[a]
Number of Thrifts	2,275	621	1,654	–	1,904	364	1,540	–
Cost of Liquidation[b]	–	0.345	–	–	–	0.217	–	–
Liquidation cost ($m)	–	128	–	–	–	89	–	–
Structural Variables[c]								
Risk-Weighted Assets[d]	0.624	0.643	0.617	*−7.11*	0.619	0.663	0.615	*3.94*
Tangible Net Worth[d]	0.047	0.024	0.055	*−10.02*	0.049	0.022	0.055	*−7.62*
Net Interest Margin[d]	0.003	0.001	0.004	*−3.79*	0.003	0.0006	0.0041	*−3.71*
Net Income[d]	−0.003	−0.002	−0.004	*2.21*	−0.004	−0.0036	−0.0038	*0.17*
Total Assets ($m)	174	224	155	*2.67*	290	514	237	*3.01*
Federal Mutual Charter	0.480	0.385	0.516	*−5.69*	0.519	0.492	0.526	*1.17*
Federal Stock Charter	0.026	0.045	0.019	*2.94*	0.026	0.060	0.018	*3.26*
State Mutual Charter	0.309	0.138	0.372	*−12.80*	0.334	0.151	0.377	*−10.03*
State Stock Charter	0.185	0.432	0.093	*16.05*	0.121	0.297	0.079	*8.72*
Texas	0.097	0.304	0.019	*15.21*	–	–	–	–
Texas State Charter	0.080	0.259	0.012	*13.88*	–	–	–	–
Florida	0.027	0.039	0.023	*1.83*	0.033	0.066	0.025	*3.03*
Florida State Charter	0.007	0.016	0.004	*2.37*	0.008	0.027	0.004	*2.70*
California	0.048	0.069	0.041	*2.55*	0.058	0.118	0.044	*4.21*
Calif. State Charter	0.029	0.047	0.022	*2.63*	0.035	0.080	0.024	*3.78*
Publicly Traded	0.016	0.023	0.014	*1.30*	0.017	0.033	0.014	*1.97*
FHLB Ninth District Membership	0.163	0.414	0.069	*16.63*	–	–	–	–

Notes: [a]Approximate *t*-statistic for significance of difference of means between failing and surviving thrifts. [b]Proportion of total liabilities as of December 31, 1985. [c]Structural characteristics as of December 31, 1982. [d]Proportion of total assets as of December 31, 1985.

TABLE 1 (contd.)

UNIVARIATE STATISTICS FOR VARIABLES USED TO EXPLAIN THE PROBABILITY OF FAILURE AND THE COST OF LIQUIDATION FOR THRIFTS

	All FHLB Districts				All FHLB Districts Except District Nine			
Variable	All Thrifts	Failing Thrifts	Surviving Thrifts	*t*-stat[a]	All Thrifts	Failing Thrifts	Surviving Thrifts	*t*-stat[a]
Behavioral Variables								
Single-Family Mortgages[b]	0.528	0.395	0.578	*−24.73*	0.552	0.435	0.580	*−16.61*
Multifamily Mortgages[b]	0.047	0.072	0.037	*10.36*	0.044	0.068	0.038	*7.40*
Nonresidential Mortgages[b]	0.080	0.132	0.061	*17.23*	0.073	0.125	0.060	*12.39*
Land Loans[b]	0.026	0.074	0.008	*14.13*	0.013	0.038	0.008	*8.01*
Mortgage-Backed Securities[b]	0.064	0.055	0.067	*−3.34*	0.068	0.069	0.068	*0.24*
Commercial Loans[b]	0.010	0.020	0.006	*9.27*	0.007	0.016	0.005	*7.98*
Consumer Loans[b]	0.043	0.056	0.038	*6.29*	0.038	0.047	0.036	*3.52*
Real Estate Owned[b]	0.010	0.026	0.004	*12.11*	0.007	0.022	0.004	*9.67*
Real Estate Investments[b]	0.004	0.011	0.001	*7.02*	0.003	0.009	0.001	*4.59*
Service Corp. Investments[b]	0.008	0.020	0.004	*8.46*	0.006	0.017	0.004	*5.79*
Equity Securities[b]	0.0004	0.0006	0.0004	*0.72*	0.0005	0.0007	0.0004	*0.80*
Junk Bonds[b]	0.0007	0.0013	0.0005	*1.82*	0.0007	0.0012	0.0006	*1.41*
Goodwill[b]	0.006	0.016	0.002	*10.97*	0.004	0.016	0.002	*7.98*
Delinquent Loans[b]	0.026	0.051	0.016	*12.83*	0.022	0.048	0.016	*10.56*
Foreclosures[b]	0.011	0.027	0.005	*10.80*	0.007	0.019	0.004	*7.36*
Tangible Net Worth[b]	0.032	−0.024	0.052	*23.03*	0.036	−0.032	0.052	*−18.46*
Expense-Preference Items[b]	0.014	0.015	0.013	*5.87*	0.013	0.015	0.013	*4.50*
Total Deposits[c]	0.933	0.888	0.950	*−14.20*	0.935	0.875	0.950	*−13.15*
Retail Deposits[c]	0.865	0.791	0.893	*−16.92*	0.875	0.894	0.793	*−13.64*
Wholesale Deposits[c]	0.065	0.095	0.054	*10.45*	0.058	0.080	0.052	*6.56*
Brokered Deposits[c]	0.013	0.031	0.005	*9.02*	0.010	0.031	0.005	*6.47*
Repurchase Agreements[c]	0.007	0.012	0.006	*3.77*	0.007	0.014	0.006	*3.89*
Liability-Growth Rate, 1983–85	0.180	0.334	0.123	*10.13*	0.153	0.282	0.123	*5.43*

Notes: [a]Approximate *t*-statistic for significance of difference of means between failing and surviving thrifts. [b]Proportion of total assets as of December 31, 1985. [c]Proportion of total liabilities as of December 31, 1985.

TABLE 2

ESTIMATES OF THE DETERMINANTS OF THE PROBABILITY OF THRIFT FAILURE[a]

Variable	Ordinary Least Squares			Single-Equation Probit			FIML Probit[b]		
	Structure	Behavior	Both	Structure	Behavior	Both	Structure	Behavior	Both
Constant	−0.234	−0.035	−0.019	−2.878	−1.832	−2.514	−2.601	−1.774	−1.704
	(−2.11)	(−1.83)	(−0.18)	(−6.03)	(−19.74)	(−4.198)	(−6.62)	(−25.15)	(−15.37)
Structural Variables[c]									
Risk-Weighted Assets[d]	0.670		0.019	2.680		0.457	2.325		[e]
	(5.73)		(0.17)	(5.44)		(0.76)	(6.24)		
Tangible Net Worth[d]	−2.157		−1.767	−7.541		−8.559	−5.395		−8.726
	(−12.15)		(−9.81)	(−10.19)		(−8.25)	(−12.32)		(−10.40)
Net Interest Margin	−1.214		−3.171	−5.635		−19.320	−4.566		−19.343
	(−1.58)		(−4.33)	(−1.75)		(−4.60)	(−1.94)		(−5.77)
State-Stock Charter	0.270		0.106	0.919		0.405	1.017		0.367
	(9.28)		(3.86)	(8.27)		(3.03)	(11.41)		(3.08)
State-Mutual Charter	−0.051		−0.028	−0.280		−0.186	−0.054		−0.178
	(−2.83)		(−1.71)	(−3.31)		(−1.94)	(−1.27)		(−1.74)
Federal-Stock Charter	0.279		0.157	0.899		0.613	0.771		0.520
	(5.31)		(3.24)	(4.59)		(2.75)	(4.10)		(2.30)
Texas	0.311		0.316	0.861		0.943	0.765		1.018
	(4.75)		(5.31)	(3.44)		(3.28)	(5.84)		(4.84)
Texas State Charter	−0.033		−0.119	0.194		0.104	[e]		[e]
	(−0.49)		(−1.89)	(0.70)		(0.33)			
California	0.020		−0.072	0.056		−0.265	[e]		[e]
	(0.34)		(−1.34)	(0.25)		(−1.05)			
Calif. State Charter	0.195		0.030	0.706		0.015	0.218		[e]
	(2.50)		(0.41)	(2.39)		(0.04)	(1.86)		
Florida	0.082		0.005	0.318		−0.017	0.172		[e]
	(1.50)		(0.11)	(1.54)		(−0.07)	(1.32)		
Florida State Charter	0.189		0.081	0.441		−0.133	[e]		[e]
	(1.74)		(0.82)	(1.11)		(−0.29)			
Size (Log of Assets)	0.008		0.004	0.047		0.045	0.027		[e]
	(1.11)		(0.60)	(1.53)		(1.19)	(0.94)		
Publicly Traded Stock	−0.188		−0.138	−0.646		−0.777	0.024		−0.686
	(−2.79)		(−2.24)	(−2.54)		(−2.70)	(0.16)		(−2.61)
FHLB Ninth District Membership	0.185		0.097	0.611		0.344	0.764		0.337
	(5.94)		(3.36)	(5.14)		(2.39)	(7.47)		(2.24)

Notes: [a]Estimates of the probability of failure during 1986–1989. For each variable, the first row presents the parameter estimate and the second row presents its *t*-statistic. [b]FIML probit results are estimated jointly with the parameters of an equation explaining expected liquidation costs as a proportion of year-end 1985 total liabilities, using a variation of the sample-selection-bias correction suggested by Heckman (1979). [c]Structural characteristics as of December 31, 1982. [d]Proportion of total assets as of December 31, 1982. [e]Variables with *p*-values greater than 0.20 in the single-equation probit results have been deleted to facilitate convergence of this procedure.

TABLE 2 (contd.)
ESTIMATES OF THE DETERMINANTS OF THE PROBABILITY OF THRIFT FAILURE[a]

Variable	Ordinary Least Squares			Single-Equation Probit			FIML Probit[b]		
	Structure	Behavior	Both	Structure	Behavior	Both	Structure	Behavior	Both
Behavioral Variables									
Multifamily Mortgages[c]		0.479	0.281		1.691	0.974		1.813	1.002
		(3.60)	(2.19)		(2.90)	(1.45)		(3.18)	(1.49)
Nonresidential Mortgages[c]		1.368	1.016		5.073	4.149		4.864	4.216
		(12.08)	(9.29)		(9.65)	(6.97)		(9.37)	(7.06)
Land Loans[c]		1.453	0.621		6.818	3.905		7.508	4.069
		(12.46)	(5.14)		(9.17)	(4.72)		(24.44)	(9.46)
Commercial Loans[c]		1.535	1.105		5.827	5.243		5.939	5.466
		(4.65)	(3.57)		(3.55)	(2.95)		(3.85)	(3.58)
Consumer Loans[c]		0.997	0.305		3.722	1.106		3.702	1.313
		(6.62)	(2.06)		(5.82)	(1.48)		(6.12)	(1.91)
Real Estate Investments[c]		2.172	1.538		10.093	8.681		10.466	8.413
		(5.60)	(4.05)		(4.22)	(3.52)		(6.83)	(4.49)
Service Corp. Investments[c]		1.034	0.253		5.820	2.352		5.115	[e]
		(3.42)	(0.87)		(3.10)	(1.15)		(3.57)	
Equity Securities[c]		0.961	0.503		2.318	−5.053		[e]	[e]
		(0.54)	(0.30)		(0.32)	(−0.62)			
Goodwill[c]		4.196	2.306		14.911	6.914		14.784	7.634
		(10.80)	(6.01)		(8.29)	(3.17)		(12.15)	(5.07)
Liability Growth, 1983–85		0.034	0.233		0.113	1.535		[e]	1.411
		(1.26)	(7.86)		(0.91)	(6.75)			(7.32)
Brokered Deposits[d]		0.744	0.752		1.508	1.488		1.890	1.560
		(4.39)	(4.69)		(2.28)	(2.04)		(4.52)	(2.94)
Wholesale Deposits[d]		0.173	−0.133		0.495	−0.694		[e]	[e]
		(1.47)	(−1.17)		(0.95)	(−1.16)			
Expense-Preference Items[c]		0.909	6.011		0.498	25.439		[e]	20.920
		(0.72)	(4.61)		(0.09)	(3.69)			(3.83)
R^2[f]	0.35	0.38	0.47	0.31	0.35	0.46			
F-Statistic	82.26	107.14	72.86						
Log-Likelihood				−920	−873	−717	−830	−727	−587

Notes: [a]Estimates of the probability of failure during 1986–1989. For each variable, the first row presents the parameter estimate and the second row presents its *t*-statistic. [b]FIML probit results are estimated jointly with the parameters of an equation explaining expected liquidation costs as a proportion of year-end 1985 total liabilities, using a variation of the sample-selection-bias correction suggested by Heckman (1979). [c]Structural characteristics as of December 31, 1982. [d]Proportion of total assets as of December 31, 1982. [e]Variables with *p*-values greater than 0.20 in the single-equation probit results have been deleted to facilitate convergence of this procedure. [f]Adjusted R^2 for OLS results; McFadden's pseudo-R^2 for probit results.

TABLE 3
ESTIMATES OF THE DETERMINANTS OF THRIFT LIQUIDATION COSTS[a]

Variable	Ordinary Least Squares			Ordinary Least Squares			FIML Probit[b]		
	Structure	Behavior	Both	Structure	Behavior	Both	Structure	Behavior	Both
Constant	0.211	−0.053	0.252	0.247	0.053	0.060	−0.658	0.278	0.243
	(1.79)	(1.92)	(2.18)	(2.20)	(1.99)	(1.97)	(−5.60)	(4.63)	(2.27)
Structural Variables[c]									
Risk-Weighted Assets[d]	0.175		0.042	0.173			0.551		e
	(1.56)		(0.40)	(1.60)			(5.23)		
Tangible Net Worth[d]	−0.278		−0.136	−0.244			−1.731		e
	(−1.73)		(−0.83)	(−1.75)			(−14.27)		
Net Interest Margin[d]	0.339		−0.210				e		e
	(0.45)		(−0.29)						
State-Stock Charter	0.082		0.021	0.090			0.323		e
	(2.82)		(0.79)	(3.86)			(12.84)		
State-Mutual Charter	−0.001		0.000				e		e
	(−0.03)		(0.01)						
Federal-Stock Charter	0.105		0.058	0.097		0.038	0.247		0.038
	(2.23)		(1.34)	(2.21)		(0.98)	(4.44)		(0.68)
Texas	−0.005		0.025				e		e
	(−0.09)		(0.53)						
Texas State Charter	0.178		0.124	0.168		0.156	0.171		0.153
	(3.35)		(2.58)	(5.00)		(5.59)	(4.57)		(5.03)
California	0.023		−0.035				e		e
	(0.36)		(−0.59)						
Calif. State Charter	0.020		−0.042				e		e
	(0.25)		(−0.56)						
Florida	−0.017		−0.044				e		e
	(−0.27)		(−0.77)						
Florida State Charter	0.054		0.008				e		e
	(0.56)		(0.10)						
Size (Log of Assets)	−0.015		−0.021	−0.018		−0.018	0.007		−0.018
	(−1.80)		(−2.69)	(−2.37)		(−2.90)	(0.77)		(−2.50)
Publicly Traded	−0.077		−0.071				e		e
	(−1.15)		(−1.16)						
FHLB District Nine	0.170		0.119	0.165		0.092	0.337		0.139
Membership	(5.42)		(4.10)	(6.25)		(5.22)	(10.55)		(5.11)

Notes: [a]Estimates of expected liquidation costs as a percentage of year-end 1985 total liabilities for thrifts failing during 1986–1989. For each variable, the first row presents the parameter estimate and the second row presents its *t*-statistic. [b]FIML probit results are estimated jointly with the parameters of an equation explaining the probability of failure, using a variation of the sample-selection-bias correction suggested by Heckman (1979). [c]Structural characteristics as of December 31, 1982. [d]Proportion of total assets as of December 31, 1982. [e]Variables with *t*-statistics less than 1.0 in absolute magnitude have been deleted to facilitate convergence of this procedure.

TABLE 3 (contd.)
ESTIMATES OF THE DETERMINANTS OF THRIFT LIQUIDATION COSTS[a]

Variable	Ordinary Least Squares			Ordinary Least Squares			FIML Probit[b]		
	Structure	Behavior	Both	Structure	Behavior	Both	Structure	Behavior	Both
Behavioral Variables									
Multifamily Mortgages[c]		0.235	0.166		0.251	0.145		0.010	0.145
		(1.85)	(1.46)		(1.99)	(1.33)		(0.73)	(1.20)
Nonresidential Mortgages[c]		0.279	0.283		0.282	0.265		−0.073	0.265
		(2.76)	(3.09)		(2.82)	(3.04)		(−0.48)	(2.57)
Land Loans[c]		1.036	0.556		1.057	0.541		0.780	0.541
		(12.19)	(6.70)		(12.74)	(6.84)		(8.29)	(8.07)
Commercial Loans[c]		0.548	0.571		0.593	0.542		0.209	0.542
		(2.11)	(2.47)		(2.32)	(2.44)		(0.69)	(2.13)
Consumer Loans[c]		0.539	−0.008		0.554			0.263	[e]
		(3.47)	(−0.06)		(3.58)			(1.32)	
Real Estate Investments[c]		0.627	0.515		0.619	0.335		0.193	0.335
		(2.27)	(1.96)		(2.26)	(1.41)		(0.69)	(1.15)
Service Corp. Investments[c]		1.303	1.349		1.378	1.218		1.092	1.217
		(5.97)	(6.69)		(6.70)	(6.70)		(7.24)	(10.83)
Equity Securities[c]		0.585	0.721					[e]	[e]
		(0.36)	(0.48)						
Goodwill[c]		1.061	0.934		1.059	1.019		0.249	1.018
		(3.61)	(3.36)		(3.62)	(3.92)		(0.78)	(3.97)
								[e]	[e]
Liability Growth, 1983–85		0.005	0.011						
		(0.25)	(0.47)						
Brokered Deposits[d]		0.118	0.217			0.182		[e]	0.181
		(0.85)	(1.72)			(1.51)			(1.48)
Wholesale Deposits[d]		0.087	−0.076					[e]	[e]
		(0.82)	(−0.78)						
Expense-Preference Items[c]		2.551	3.032		2.793	2.424		2.535	2.424
		(2.06)	(2.47)		(2.31)	(2.19)		(2.08)	(2.16)
1986 Failure	0.009	−0.046	−0.015				[e]	[e]	[e]
	(0.21)	(−1.10)	(−0.39)						
1987 Failure	−0.000	−0.062	−0.028		−0.059		[e]	−0.052	[e]
	(−0.01)	(−1.60)	(−0.82)		(−1.55)			(−0.88)	
1988 Failure	0.119	0.082	0.086	0.119	0.085	0.092	0.059	0.085	0.092
	(5.84)	(3.96)	(4.61)	(6.11)	(4.17)	(5.22)	(4.83)	(3.86)	(5.11)
Correlation of error terms[f]							0.993	−0.514	−0.001
							(406.24)	(−5.22)	(−0.01)
R^2	0.40	0.37	0.52	0.41	0.38	0.53			
F-Statistic	24.13	24.19	23.00	54.65	35.05	50.66			

Notes: [a]Estimates of expected liquidation costs as a percentage of year-end 1985 total liabilities for thrifts failing during 1986–1989; *t*-statistics in parentheses. [b]See note b to Table 3. [c]Proportion of total assets as of December 31, 1982. [d]Proportion of total liabilities as of December 31, 1982. [e]Variables with *p*-values greater than 0.20 in the single-equation results were deleted to facilitate convergence of this procedure. [f]Estimated correlation between the error terms in the failure and cost equations.

TABLE 4
FIML ESTIMATES OF THE DETERMINANTS OF THRIFT FAILURE AND THRIFT LIQUIDATION COSTS[a]

Variable	All FHLB Districts Except District Nine		All FHLB Districts	
	Failure	Liquidation Cost	Failure	Liquidation Cost
Constant	−1.604	0.243	−1.704	0.243
	(−13.27)	(2.85)	(−15.37)	(2.27)
Structural Variables[b]				
Tangible Net Worth[c]	−8.294		−8.726	
	(−8.39)		(−10.40)	
Net Interest Margin[c]	−16.770		−19.343	
	(−4.12)		(−5.77)	
State-Stock Charter	0.449		0.367	
	(3.28)		(3.08)	
State-Mutual Charter	−0.211		−0.178	
	(−1.95)		(−1.74)	
Federal-Stock Charter	0.553	0.011	0.520	0.038
	(2.39)	(0.34)	(2.30)	(0.68)
Texas			0.765	
			(5.84)	
Texas State Charter				0.153
				(5.03)
Size (Log of Assets)		−0.014		−0.018
		(−2.42)		(−2.50)
Publicly Traded	−0.692		−0.686	
	(−2.57)		(−2.61)	
FHLB District Nine Membership			0.337	0.139
			(2.24)	(4.14)

Notes: [a]FIML results obtained by jointly estimating an equation explaining the probability of thrift failure during 1986–1989 and an equation explaining the expected liquidation cost for these thrifts expressed as a proportion of year-end 1985 total liabilities, using a variation of the sample-selection-bias correction suggested by Heckman (1979); *t*-statistics shown in parentheses. [b]Structural characteristics as of December 1982. [c]Proportion of total assets as of December 1982.

TABLE 4 (contd.)

Variable	All FHLB Districts Except District Nine		All FHLB Districts	
	Failure	Liquidation Cost	Failure	Liquidation Cost
Behavioral Variables				
Multifamily Mortgages[b]	0.828	−0.104	1.002	0.145
	(1.13)	(−0.97)	(1.49)	(1.20)
Nonresidential Mortgages[b]	3.928	0.274	4.216	0.265
	(5.95)	(2.95)	(7.06)	(2.57)
Land Loans[b]	3.662	0.581	4.069	0.541
	(7.99)	(7.11)	(9.46)	(8.07)
Commercial Loans[b]	7.713	0.376	5.466	0.542
	(3.68)	(1.17)	(3.58)	(2.13)
Consumer Loans[b]	1.651		1.313	
	(1.97)		(1.91)	
Real Estate Investments[b]	9.389	0.263	8.413	0.335
	(4.33)	(1.18)	(4.49)	(1.15)
Service Corp. Investments[b]		0.705		1.217
		(4.04)		(10.83)
Goodwill[b]	9.164	0.735	7.634	1.018
	(5.70)	(2.62)	(5.07)	(3.97)
Liability Growth, 1983–85	1.200		1.411	
	(5.56)		(7.32)	
Brokered Deposits[c]	1.645	0.151	1.560	0.181
	(2.80)	(2.12)	(2.94)	(1.48)
Expense-Preference Items[b]	13.687	1.919	20.920	2.424
	(2.35)	(2.81)	(3.83)	(2.16)
1988 Failure		0.108		0.092
		(7.31)		(5.11)
Correlation of error terms		−0.109		−0.001
		(−0.50)		(−0.01)
Sample Size	1,904	364	2,275	621

See notes on facing page.

TABLE 5
1985 BEHAVIORAL VARIABLES AS FUNCTIONS OF
1982 STRUCTURAL VARIABLES (OLS ESTIMATES)[a]

Structural Variables[b]	Behavioral: Multi-family Mort-gages[c]	Non-resid-ential Morts.[c]	Land Loans[c]	Comm. Loans[c]	Con-sumer Loans[c]	Real Estate Invest-ment[c]
Intercept	−0.168	−0.112		−0.026		−0.021
Risk-Weighted Assets[e]	0.177	0.252		0.029	0.132	0.180
Tangible Net Worth[e]		−0.224		−0.047	−0.133	
Net Interest Margin[e]				0.187	0.269	−0.129
State-Stock Charter	0.015	0.025	0.033	0.010		0.003
State-Mutual Charter		−0.016				
Federal-Stock Charter	0.019	0.026	0.034	0.012		
Texas			0.046	−0.013		
Texas State Charter			0.040			0.011
California	0.056					
Calif. State Charter		0.050				0.039
Florida		0.022		0.007		
Florida State Charter	0.043		0.045			
Size (Log of Assets)	0.009	0.003		0.001	−0.003	0.001
Publicly Traded	−0.024					−0.010
FHLB District Nine Membership		0.028	0.017	0.012	0.020	
Adjusted R^2	0.15	0.20	0.29	0.09	0.09	0.15
F-Statistic	26.76	38.09	62.33	15.26	16.58	28.73

Notes: [a]All 2,275 sample institutions are included in these regressions. Only coefficients significant at least at the 5 percent level are reported. [b]Structural characteristics as of December 31, 1982. [c]Proportion of total assets as of December 31, 1985. [d]Proportion of total liabilities as of December 31, 1985. [e]Proportion of total assets as of December 31, 1982.

TABLE 5 (contd.)
1985 BEHAVIORAL VARIABLES AS FUNCTIONS OF
1982 STRUCTURAL VARIABLES (OLS ESTIMATES)[a]

Variables: Service Corp. Invest-ment[c]	Equity Invest-ment[c]	Good-will[c]	Whole-sale Deposits[d]	Brokered Deposits[d]	Repo Agree-ments[d]	Lia-bility Growth, 1983–85	Expense-prefer-ence Items[c]
−0.036		−0.025			−0.044	−0.166	0.022
0.034		0.022		0.029	−0.032	0.588	
−0.032		−0.112	−0.143	−0.069	−0.036	1.534	−0.020
−0.155	−0.028	0.120	0.656		0.244	1.909	0.153
0.011	0.001	0.008	0.035	0.029	0.075	0.165	0.003
			−0.007			−0.032	
	0.002	0.010	0.046			0.058	0.002
0.015		0.012		−0.018		0.109	
0.009	0.002		0.024	0.046		0.088	0.005
0.021		0.014		−0.023		0.019	−0.003
			0.053			0.131	0.002
0.021	0.003	0.015	0.079			0.115	
0.002		0.002			0.006	−0.014	−0.001
0.010	0.004	−0.009		0.025	0.040		
			0.033	0.012		0.061	
0.14	0.04	0.16	.020	0.10	0.12	0.34	0.20
26.66	7.56	30.90	38.91	17.79	20.88	78.22	39.33